COMMON KNOWLEDGE

On Technical Mediation —

Philosophy, Sociology, Genealogy

Bruno Latour

A fter Daedalus' escape from the labyrinth, according to Apollodorus, Minos used one of Daedalus' own subterfuges to find his hiding place and take revenge. Minos, in disguise, heralded near and far his offer of a reward to anyone who could thread the convoluted shell of a snail. Daedalus, hidden at the court of King Cocalus and unaware that the offer was a trap, managed the trick by replicating Ariadne's cunning: he attached a thread to an ant and, after allowing it to penetrate the shell through a hole at its apex, he induced the ant to weave its way through this tiny labyrinth. Triumphant, Daedalus claimed his reward, but King Minos, equally triumphant, asked for Daedalus' extradition to Crete. Cocalus abandoned Daedalus; still, the artful dodger managed, with the help of Minos' daughters, to divert the hot water from pipes he had installed in the palace, so that it fell, as if by accident, on Minos in his bath. (The king died, boiled like an egg.) Only for a brief while did Minos outwit his master engineer—Daedalus was always one ruse, one machination, beyond his rivals.

In the myth of Daedalus, all things deviate from the straight line. The direct path of reason and scientific knowledge—episteme—is not the path of every Greek. The clever technical know-how of Daedalus is an instance of *metis*, of strategy, of the sort of intelligence for which Odysseus (of whom the *Iliad* says that he is *polymetis*, a bag of tricks) is most famed.[1] No unmediated action is possible once we enter the realm of engineers and craftsmen. A *daedalion*, in Greek, is something curved, veering from the straight line, artful but fake, beautiful and contrived. Daedalus is an inventor of

[1] For the myth of Daedalus, I am here following the remarkable book by Françoise Frontisi-Ducroux, *Dédale. Mythologie de l'artisan en Grèce ancienne* (Paris: Maspéro-La Découverte, 1975).

contraptions: statues that seem to be alive, military robots that watch over Crete, an ancient version of genetic engineering that enables Poseidon's bull to impregnate Pasiphae with the Minotaur—for whom he builds the labyrinth, from which, via another set of machines, he manages to escape, losing his son Icarus on the way . . . despised, indispensable, criminal, ever at war with the three kings who draw their power from his machinations. Daedalus is our best eponym for *technique*—and the concept of *daedalion* our best tool to penetrate the evolution of civilization. His path leads through three disciplines: philosophy, sociology, genealogy.

PHILOSOPHY

To understand techniques—technical means—and their place in society, we have to be as devious as the ant to which Daedalus attached his thread. The straight lines of philosophy are of no use when it is the crooked labyrinth of machinery and machinations, of artifacts *and daedalia,* we have to explore. That Heidegger's interpretation of technology passes as the deepest of interpretations I find surprising.[2] To cut a hole at the apex of the shell and weave my thread, I need to define, in opposition to Heidegger, what *mediation* means in the realm of techniques.

For Heidegger, a technology is never an instrument, a mere tool. Does that mean that technologies mediate action? No, because we have ourselves become instruments for no other end than instrumentality itself. Man—no Woman in Heidegger—is possessed by technology, and it is a complete illusion to believe that we can master it. We are, on the contrary, framed by this *Gestell,* which is in itself one way in which Being is unveiled. . . . Is technology inferior to science and pure knowledge? No, because, for Heidegger, far from serving as applied science, technology dominates all, even the purely theoretical sciences. By rationalizing and stockpiling nature, science plays into the hands of technology, whose sole end is to rationalize and stockpile nature without end. Our modern destiny—technology—appears to Heidegger radically different from *poesis,* the kind of "making" that ancient craftsmen knew how to obtain. Technology is entirely unique, insuperable, omnipresent, superior, a monster born in our midst.

But Heidegger is mistaken. I will try to show how and in what way he is wrong about technical mediation by using a simple, well-known example.

"Guns kill people" is a slogan of those who try to control the unrestricted sale of guns. To which the National Rifle Association replies with another slogan, "People

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[2]Martin Heidegger, *The Question Concerning Technology and Other Essays,* trans. William Lovitt (New York: Harper Torch Books, 1977).

kill people; not guns." The first slogan is materialist: the gun acts by virtue of material components irreducible to the social qualities of the gunman. On account of the gun, a good guy, the law-abiding citizen, becomes dangerous. The NRA, on the other hand, offers (amusingly enough, given their political views) a sociological version more often associated with the Left: for the NRA, the gun does nothing in itself or by virtue of its material components. The gun is a tool, a medium, a neutral carrier of will. If the gunman is a good guy, the gun will be used wisely and will kill only apropos. If the gunman is a crook or a lunatic, then, with no change in the gun itself, a killing that would in any case occur will be (simply) carried out more efficiently. What does the gun add to the shooting? In the materialist account, everything: an innocent citizen becomes a criminal by virtue of the gun in her hand. The gun enables of course, but also instructs, directs, even pulls the trigger—and who, with a knife in her hand, has not wanted at some time to stab someone or something? Each artifact has its script, its "affordance," its potential to take hold of passersby and force them to play roles in its story. By contrast, the sociological version of the NRA renders the gun a neutral carrier of will that adds nothing to the action, playing the role of an electrical conductor, good and evil flowing through it effortlessly.

The two positions are absurdly contradictory. No materialist claims that guns kill by themselves. What the materialist claims is that the good citizen is transformed by carrying the gun. A good citizen who, without a gun, might simply be angry may become a criminal if he is holding a gun—as if the gun had the power to change Dr. Jekyll into Mr. Hyde. Materialists thus make the intriguing suggestion that our quality as subjects, our competences, our personalities, depend on what we hold in our hands. Reversing the dogma of moralism, the materialists insist that we are what we have—what we have in our hands, at least.

As to the NRA, they cannot maintain that the gun is so neutral an object that it has no part in the act of killing. They have to acknowledge that the gun adds something, though not to the moral state of the person holding the gun. For the NRA, one's moral state is a Platonic essence: One is born a good citizen or a criminal. Period. As such, the NRA account is moralist—what matters is what you are, not what you have. The sole contribution of the gun is to speed the act. Killing by fists or knives is slower, dirtier, messier. With a gun, one kills better, but at no point does it modify one's goal. Thus, NRA sociologists are making the troubling suggestion that we can master techniques, that techniques are nothing more than pliable and diligent slaves.

Who or what is responsible for the act of killing? Is the gun no more than a piece of mediating technology? The answer to these questions depends upon what *mediation* means. A first sense of *mediation* (I will offer four) is the *program of action*, the series of goals and steps and intentions, that an agent can describe in a story like my vignette
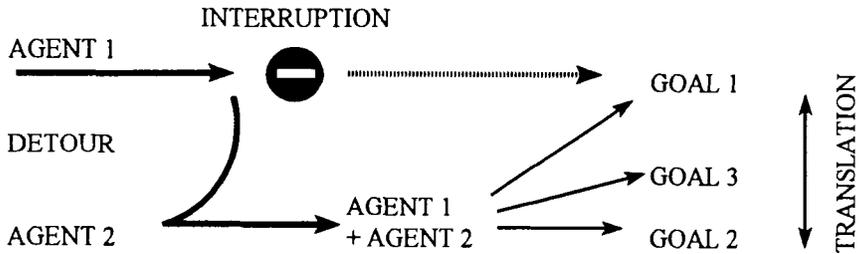
Fig. 1. First Meaning of Mediation: Translation

of the gun (fig. 1). If the agent is human, is angry, wants to take revenge, and if the accomplishment of the agent's goal is interrupted, for whatever reason (perhaps the agent is not strong enough), then the agent makes a detour, a deviation: as we have already seen, one cannot speak of techniques without speaking of *daedalia*. Agent 1 falls back on Agent 2, here a gun. Agent 1 enlists the gun or is enlisted by it—it does not matter which—and a third agent emerges from a fusion of the other two.

The question now becomes which goal the new composite agent will pursue. If it returns, after its detour, to Goal 1, then the NRA story obtains. The gun is a tool, merely an intermediary. If Agent 3 drifts from Goal 1 to Goal 2, then the materialists' story obtains. The gun's intent, the gun's will, the gun's script have superseded those of Agent 1; it is human action that is no more than an intermediary. Note that in the diagram it makes no difference if Agent 1 and Agent 2 are reversed. The myth of the Neutral Tool under complete human control and the myth of the Autonomous Destiny that no human can master are symmetrical. But a third possibility is more commonly realized: the creation of a new goal that corresponds to neither agent's program of action. (You had wanted only to hurt but, with a gun now in hand, you want to kill.) I call this uncertainty about goals *translation*. I have used this term a number of times and encounter each time the same misunderstandings.[3] Translation does not mean a shift from one vocabulary to another, from one French word to one English word, for instance, as if the two languages existed independently. Like Michel Serres, I use *translation* to mean displacement, drift, invention, mediation, the creation of a link that did not exist before and that to some degree modifies two elements or agents.

Who, then, is the actor in my vignette? *Someone else* (a citizen-gun, a gun-citizen). If we try to understand techniques while assuming that the psychological capacity of humans is forever fixed, we will not succeed in understanding how techniques are created nor even how they are used. You are a different person with the gun in your

[3]In particular, in Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (Cambridge: Harvard University Press, 1987). My use of the word *translation* comes from Michel Serres through Michel Callon's sociological usage: "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St. Brieuc Bay," in *Power, Action, and Belief: A New Sociology of Knowledge?* ed. John Law (London: Routledge & Kegan Paul, 1986), 196–229.

hand. Essence is existence and existence is action. If I define you by what you have (the gun), and by the series of associations that you enter into when you use what you have (when you fire the gun), then you are modified by the gun—more so or less so, depending on the weight of the other associations that you carry. This translation is wholly symmetrical. You are different with a gun in hand; the gun is different with you holding it. You are another subject because you hold the gun; the gun is another object because it has entered into a relationship with you. The gun is no longer the gun-in-the-armory or the gun-in-the-drawer or the gun-in-the-pocket, but the gun-in-your-hand, aimed at someone who is screaming. What is true of the subject, of the gunman, is as true of the object, of the gun that is held. A good citizen becomes a criminal, a bad guy becomes a worse guy; a silent gun becomes a fired gun, a new gun becomes a used gun, a sporting gun becomes a weapon. The twin mistake of the materialists and the sociologists is to start with essences, those of subjects *or* those of objects. That starting point renders impossible our measurement of the mediating role of techniques. Neither subject nor object (nor their goals) is fixed.

It is, now, possible to shift our attention to the *someone else,* the hybrid actor composed (for instance) of gun and gunman. We must learn to attribute—redistribute—actions to many more agents than is acceptable to either the materialist or the sociological account. Agents can be human or (like the gun) nonhuman, and each can have goals (or functions, as engineers prefer to say). Since the word *agent* in the case of nonhumans is uncommon, a better term is *actant,* a borrowing from semiotics that describes any entity that acts in a plot until the attribution of a figurative or nonfigurative role ("citizen," "weapon").[4] Why is this nuance important? Because, for example, in my vignette, I could replace the gunman with "a class of unemployed loiterers," translating the individual agent into a collective, or I could talk of "unconscious motives," translating it into a subindividual agent. I could redescribe the gun as "what the gun lobby puts in the hands of unsuspecting children," translating it from an object into a collective person, an institution, or a commercial network; or I could define the gun as "the action of a trigger on a cartridge through the intermediary of a spring and a firing-pin," translating it into a mechanical series of causes and consequences.

The difference between actor and actant is exactly the same as in a fairy tale where the sudden performance of a hero may be attributed to a magic wand, or to a horse, or to a dwarf, or to birth, or to the gods, or to the hero's inner competence. A single actant may take many different "actantial" shapes, and conversely the same actor may play many different "actorial" roles. The same is true of goals and functions, the former associated more with humans, the latter with nonhumans, but both can be described as programs of action—a neutral term useful when an attribution of human goals or

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[4]See the definition in A. J. Greimas and J. Courtès, eds., *Semiotics and Language: An Analytical Dictionary* (Bloomington: Indiana University Press, 1982).
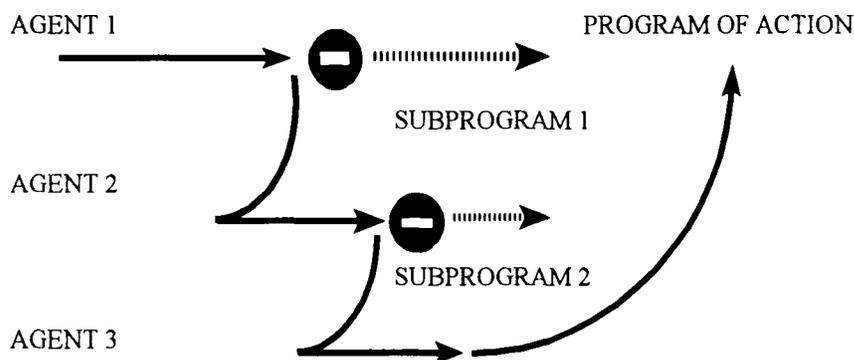
Fig. 2. Second Meaning of Mediation: Composition

nonhuman functions has not been made. Do the guns of *Roger Rabbit* or the clock and candle of Disney's *Beauty and the Beast* have goals or functions? That depends on the degree of anthropomorphism involved.[5]

These examples of actor-actant symmetry force us to abandon the subject-object dichotomy, a distinction that prevents understanding of techniques and even of societies. It is neither people nor guns that kill. Responsibility for action must be shared among the various actants. And this is the first of the (four) meanings of *mediation.*

One might object, of course, that a basic asymmetry lingers—women make electronic chips but no computer has ever made women. Common sense, however, is not the safest guide here, any more than it is in the sciences. The difficulty we just considered in the example of the gun remains, and the solution is the same: the prime mover of an action becomes a new, distributed, and nested series of practices whose sum might be made but only if we respect the mediating role of all the actants mobilized in the list.

To be convincing on this point will require a short inquiry into the way we talk about tools. When someone tells a story about the invention, fabrication, or use of a tool, whether in the animal kingdom or the human, whether in the psychological laboratory or the historical or the prehistoric, the literary structure is the same (fig. 2).[6] Some agent has a goal or goals; suddenly, the access to the goal is interrupted by that breach in the straight path that distinguishes *metis* from episteme. The detour, a

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[5] This position has triggered a lively debate on the difference between agent, actor, and actant. See Harry Collins and Steven Yearley, "Epistemological Chicken," in *Science as Practice and Culture,* ed. Andrew Pickering (Chicago: University of Chicago Press, 1992), 301–26, and the response in the same volume, Michel Callon and Bruno Latour, "Don't Throw the Baby Out with the Bath School! A Reply to Collins and Yearley," 343–68.

[6] See, for instance, Benjamin B. Beck, *Animal Tool Behavior: The Use and Manufacture of Tools* (New York: Garland, 1980).

daedalion, begins. The agent, frustrated, turns in a mad and random search, and then, whether by insight or Eureka or by trial and error—there are various psychologies available to account for this moment—the agent seizes upon some other agent—a stick, a partner, an electrical current—and then, so the story goes, returns to the previous task, removes the obstacle, and achieves the goal. Of course, in most tool stories there is not one but two or several subprograms nested in one another. A chimpanzee might seize a stick and, finding it too blunt, begin, after another crisis, another subprogram to sharpen the stick, inventing en route a compound tool. (How far the multiplication of these subprograms can continue raises interesting questions in cognitive psychology and evolutionary theory.)

Although one can imagine many other outcomes (for instance, the loss of the original goal in the maze of subprograms), let us suppose that the original task is resumed. The *composition* of the action here is interesting—the lines lengthen at each step. Who performs the action? Agent 1 plus Agent 2 plus Agent 3. Action is a property of associated entities. Agent 1 is allowed, authorized, enabled by the others. The chimp plus the sharp stick reach (and not *reaches*) the banana. The attribution to one actor of the role of prime mover in no way weakens the necessity of a *composition* of forces to explain the action. It is by mistake, or unfairness, that our headlines read, "Man flies," "Woman goes into space." Flying is a property of the whole association of entities that includes airports and planes, launch pads and ticket counters. B-52s do not fly, the U.S. Air Force flies. Action is simply not a property of humans but of an association of actants, and this is the second sense of what I intend by technical mediation. Provisional "actorial" roles may be attributed to actants only because actants are in the process of exchanging competences, offering one another new possibilities, new goals, new functions. Thus, symmetry holds in the case of fabrication as in the case of use.

But what does *symmetry* mean? Any given symmetry is defined by what is conserved through transformations. In the symmetry between humans and nonhumans, I keep constant the series of competences, of properties, that agents are able to swap by overlapping each other. I want to situate myself at the stage before we can clearly delineate humans and nonhumans, goals and functions, form and matter, before the swapping of properties and competences is observable and interpretable. Full-fledged human actors, and respectable objects out there in the world, cannot be my starting point; they may be our point of arrival. Does such a place exist? Is it more than a myth?

This principle of symmetry may be used to map out the many well-established myths that tell us we have been made by our tools. The expression *Homo faber* or, better, *Homo faber fabricatus* describes, for Hegel and Leroi-Gourhan and Marx and Bergson, a dialectical movement that ends by making us sons and daughters of our own works.[7] As for Heidegger, the relevant myth is that "So long as we represent technology as an

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. . . . translated into English, by André Leroi-Gourhan, *Le Geste et la*
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instrument, we remain held fast in the will to master it. We press on past the essence of technology."[8] We will see later what can be done with dialectics and the *Gestell*, but if inventing myths is the only way to get on with the job, we should not hesitate to invent new ones.

Why is it so difficult to measure, with any precision, the mediating role of techniques? Because the action that we are trying to measure is subject to "blackboxing," a process that makes the joint production of actors and artifacts entirely opaque. Daedalus' maze is shrouded in secrecy. Can we open the labyrinth and *count* what is inside?

Take, for instance, an overhead projector. It is a point in a sequence of action (in a lecture, say), a silent and mute intermediary, taken for granted, completely determined by its function. Now, suppose the projector breaks down. The crisis reminds us of the projector's existence. As the repairmen swarm around it, adjusting this lens, tightening that bulb, we remember that the projector is made of several parts, each with its role and function and its relatively independent goals. Whereas a moment before, the projector scarcely existed, now even its parts have individual existence, each its own "black box." In an instant, our "projector" grew from being composed of zero parts to one to many. How many actants are really there? The philosophy of technology has little use for arithmetic. . . .

The crisis continues. The repairmen fall back into a well-routinized sequence of actions, replacing parts. It becomes clear that their actions are composed of steps in a sequence that integrates several human gestures. We no longer focus on an object but see a group of people around an object. A shift has occurred between actant and mediator. Figures 1 and 2 showed how goals are redefined by association with nonhuman actants, and how action is a property of the whole association, not particularly of those actants called human. However, as figure 3 shows, the situation is still more confused, since the number of actants varies from step to step. The composition of objects also varies: sometimes objects appear stable, sometimes they appear agitated, like a group of humans around a malfunctioning artifact/quasi-object/quasi-subject. Thus, the projector counts for one, for nothing, for one hundred parts, for so many humans, for no human—and each part itself may count for one, for zero, for many, for an object, for a group. In the seven steps of figure 3, each action may proceed toward either the dispersion of actants or their integration into a single whole (a whole that, soon after, will count for nothing). Some contemporary Western philosophies can account for step 7 or step 2, or both, but what is required, what I propose to develop, is a philosophy that accounts for all seven steps.

Look around the room in which you are puzzling over figure 3. Consider how many black boxes there are in the room. Open the black boxes; examine the assemblies in-

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[8]Heidegger, *Question Concerning Technology*, 32.

A O———————▶	Step 1: disinterest
B O———————▶	
A O—————▶	Step 2: interest (interruption, detour, enlistment)
B O————▶	
A O—⌐ C	Step 3: composition of a new goal
B O—╯——▶	
A O╲ C	Step 4: obligatory passage point
B O╱—O	
A O——O——O C	Step 5: alignment
B	
D (ABC)	Step 6: blackboxing
D O———————▶	Step 7: convergence
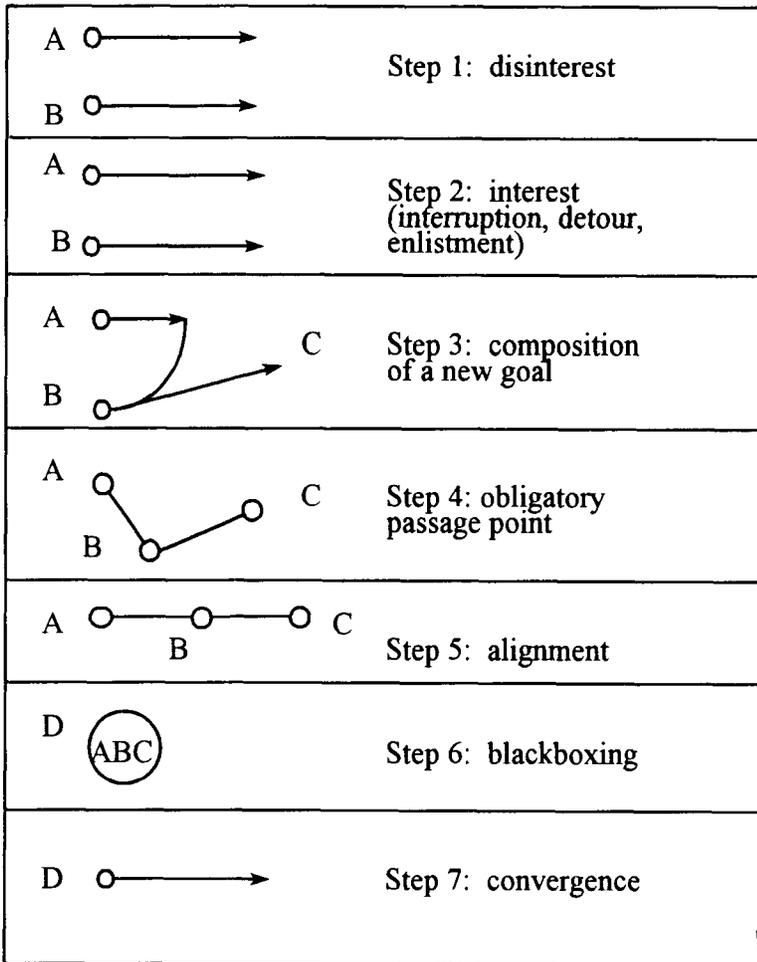
Fig. 3. Third Meaning of Mediation: Reversible Blackboxing

side. Each of the parts inside the black box is a black box full of parts. If any part were to break, how many humans would immediately materialize around each? How far back in time, away in space, should we retrace our steps to follow all those silent entities that contribute peacefully to your reading this article at your desk? Return each of these entities to step 1; imagine the time when each was disinterested and going its own way, without being bent, enrolled, enlisted, mobilized in any of the others' plots. From which forest should we take our wood? In which quarry should we let the stones quietly rest? Most of these entities now sit in silence, as if they did not exist, invisible, transparent, mute, bringing onto the present scene their force and their action from who knows how many millions of years past. They have a peculiar ontological status, but does this mean that they do not act, that they do not mediate action? Can we say that because we have made all of them—who is this "we," by the way? not I, certainly—they should be considered slaves or tools or merely evidence of a *Gestell?* The depth of our ignorance about techniques is unfathomable. We are not

able even to count their number, nor can we tell whether they exist as objects or as assemblies or as so many sequences of skilled actions. . . .

Yet there remain philosophers who believe there are such things as objects.

The reason for such ignorance is made clearer in considering the fourth and most important meaning of *mediation*. To this point, I have used the terms *story* and *program of action, goal* and *function, translation* and *interest, human* and *nonhuman*, as if techniques were stay-put denizens of the world of discourse. But techniques modify the matter of our expression, not only its form. Techniques have meaning, but they produce meaning via a special type of articulation that crosses the commonsense boundary between signs and things.

A simple example of what I have in mind: a speed bump that forces drivers to slow down on campus. The driver's goal is translated, by means of the speed bump, from "slow down so as not to endanger students" into "slow down and protect my car's suspension." The two goals are far apart, and we recognize here the same displacement as in our gun story. The driver's first version appeals to morality, enlightened disinterest, and reflection, whereas the second appeals to pure selfishness and reflex action. In my experience, there are many more people who would respond to the second than to the first: selfishness is a trait more widely distributed than respect for law and life— at least in France. The driver modifies his behavior through the mediation of the speed bump: he falls back from morality to force. But from an observer's point of view, it does not matter through which channel a given behavior is attained. From her window, the chancellor sees that cars are slowing down and, for her, that is enough.

The transition from reckless to disciplined drivers has been effected through yet another detour. Instead of signs and warnings, the campus engineers have used concrete. In this context, the notion of detour, of translation, should be modified not only (as with previous examples) to absorb a shift in the definition of goals and functions, but also a change in the very matter of expression. The engineers' program of action, "make drivers slow down on campus," is now inscribed in concrete. Instead of "inscribed," I could have said "objectified" or "reified" or "realized" or "materialized" or "engraved," but these words imply an all-powerful human agent imposing his will on shapeless matter, while nonhumans also act, displace goals, and contribute to their redefinition.[9] The fourth meaning of *translation* thus depends on the three preceding.

Not only has one meaning, in our example, been displaced into another, but an action (the enforcement of the speed law) has been translated into another kind of expression. The engineers' program is inscribed in concrete and, in considering this

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[9]See, for developed examples, Bruno Latour, "Where Are the Missing Masses? Sociology of a Few Mundane Artefacts," in *Shaping Technology-Building Society: Studies in Sociotechnical Change*, ed. Wiebe Bijker and John Law (Cambridge: MIT Press, 1992), 225–59; and, more recently, Bruno Latour, *La clef de Berlin—et autres leçons d'un amateur de sciences* (Paris: La Découverte, 1993).
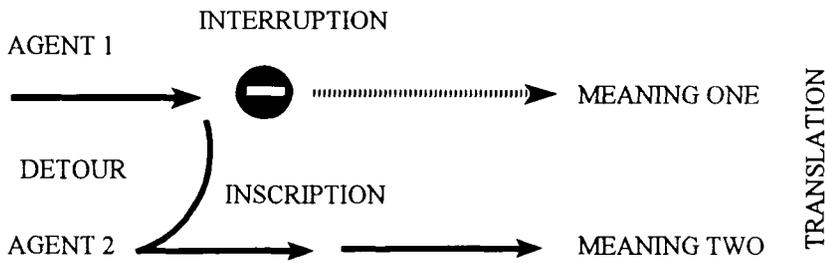
Fig. 4. Fourth Meaning of Mediation: Delegation

shift, we quit the relative comfort of linguistic metaphor and enter unknown territory. We have not abandoned meaningful human relations and abruptly entered a world of brute material relations—although this might be the impression of drivers, used to dealing with negotiable signs, now confronted by nonnegotiable speed bumps. The shift is not from discourse to matter because, for the engineers, the speed bump is one meaningful articulation within a gamut of possibilities among which they choose as freely as one chooses vocabulary in a language. Thus, we remain in meaning *but no longer in discourse*; yet we do not reside among mere objects. Where are we?

Detour, translation, delegation, inscription, and displacement require our better comprehension before we can even begin to elaborate a philosophy of techniques; and understanding these requires that we understand what semioticians call *shifting*.[10] If I say to you, for instance, "Let us imagine ourselves in the campus engineers' shoes when they decided to install the speed bumps," I transport you not only into another space and time but translate you into another actor. I *shift* you out of the scene you presently occupy. The point of spatial, temporal, and "actorial" shifting, which is basic to all fiction, is to make you move without your moving. You made a detour through the engineers' office, but without leaving your seat. You lent me, for a time, a character who, with the aid of your patience and imagination, traveled with me to another place, became another actor, then returned to become yourself in your own world again. This mechanism is called *identification*, by means of which the "enunciator"—I—and the "enunciatee"—you—both contribute to our shifting delegates of ourselves in other composite frames of reference (Fig. 4).

In the case of the speed bumps, the shift is "actorial": the "sleeping policeman," as the bump is known, is not a policeman, does not resemble one in the least. The shift is also spatial: on the campus road there now resides a new actant that slows down cars (or damages them). Finally, the shift is temporal: the bump is there night and day. But the enunciator of this technical act has disappeared from the scene—where are the engineers? where is the policeman?—while someone, something, reliably acts as lieu-

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[10]See Greimas and Courtès, *Semiotics and Language*. On shifting, see also Thomas Pavel, *Fictional Worlds* (Cambridge: Harvard University Press, 1986).

tenant, holding the enunciator's place. Supposedly the copresence of enunciators and enunciatees is necessary for an act of fiction to be possible, but what we now have are an absent engineer, a constantly present speed bump, and an enunciatee who has become the employer of an artifact; as if I were to stop writing this article and its meaning would go on being articulated, but more reliably and speedily in my absence.

You may object that this is not surprising. To be transported in imagination from France to Bali is not the same as to take a plane from France to Bali. True enough, but *how* great is the difference? In imaginative means of transportation, you simultaneously occupy all frames of reference, shifting into and out of all the delegated personae that the storyteller offers. Through fiction, *ego, hic, nunc* may be shifted, may become other personae, in other places, at other times. But aboard the plane, I cannot occupy more than one frame of reference at a time. I am seated in an object-institution that connects two airports through an airline. The act of transportation has been shifted *down* and not *out*—down to planes, engines, and automatic pilots, object-institutions to which has been delegated the task of moving while the engineers and managers are absent (or limited to monitoring). The copresence of enunciators and enunciatees has collapsed along with frames of reference. An object stands in for an actor and creates an asymmetry between absent makers and occasional users. Without this detour, this shifting down, we would not understand how an enunciator could be absent: Either it is there, we would say, or it does not exist. But by shifting down, another combination of absence and presence becomes possible. It is not, as in fiction, that I am here *and* elsewhere, that I am myself *and* someone else, but that an action, long past, of an actor, long disappeared, is still active here, today, on me—I live in the midst of technical delegates.

The whole philosophy of techniques has been preoccupied by this detour. Think of technology as congealed labor. Consider the very notion of investment: A regular course of action is suspended, a detour is initiated via several types of actants, and the return is a fresh hybrid that carries past acts into the present and permits its many makers to disappear while also remaining present. Such detours subvert the order of time—in a minute I may mobilize forces locked in motion hundreds or millions of years ago. The relative shapes of actants and their ontological status may be completely reshuffled—techniques act as shape-changers, making a cop out of a bump in the road, lending a policeman the permanence and obstinacy of stone. The relative ordering of presence and absence is redistributed—we hourly encounter hundreds, even thousands, of absent makers who are remote in time and space yet simultaneously active and present. And through such detours, finally, the political order is subverted, since I rely on many delegated actions that themselves make me do things on behalf of others who are no longer here and that I have not elected and the course of whose existence I cannot even retrace.

A detour of this kind is not easy to understand, and the difficulty is compounded

by the accusation of fetishism made by critics of technology.[11] It is us, the human makers (so they say), that you see in those machines, those implements, us under another guise, our own hard work. We should restore the human agency (so they command) that stands behind those idols. We heard this story told, to different effect, by the NRA: Guns do not act on their own, only humans do so. A fine story, but too late. Humans are no longer by themselves. Our delegation of action to other actants that now share our human existence is so far progressed that a program of antifetishism could only lead us to a nonhuman world, a world before the mediation of artifacts, a world of baboons.

On the other hand, we cannot fall back on materialism either. In artifacts and technologies we do not find the efficiency and obduracy of matter, imprinting chains of cause and effect onto malleable humans. The speed bump is not made of matter, ultimately; it is full of engineers and chancellors and lawmakers, commingling their wills and their story lines with those of gravel, concrete, paint, and standard calculations. The mediation, the technical translation, that I am trying to understand resides in the blind spot where society and matter exchange properties. The story I am telling is not a *Homo faber* story, where the courageous innovator breaks away from the constraints of social order, to make contact with hard and inhuman but—at last—objective matter. I am struggling to approach the zone where some, though not all, of the characteristics of concrete become policemen, and some, though not all, of the characteristics of policemen become speed bumps. . . .

Daedalus folds, weaves, plots, contrives, finds solutions where none is visible, using any expedient at hand in the cracks and gaps of ordinary routines, swapping properties among inert and animal and human materials. Heidegger is no Daedalus: he sees no mediation, no letting go, no stepping aside, no *poesis* in the technical world, only intermediaries, a terrifying kind of intermediary, eating away at the artisan and the engineer, at all humans, turning them into purposeless instruments for the purposeless goals of technology. In multiplying mediators, am I falling victim to the humanistic illusion ridiculed by Heidegger? Or perhaps I am falling into the materialistic trap of attributing social, ethical, and political mores to artifacts, which they cannot possibly possess. I think that the philosophy of technology forces us to relocate humanism.

Humanism is not to be found at the right pole of Figure 5, where the word *humanism* is found—nor in imagining some demiurgic Prometheus imposing an arbitrary form on shapeless matter, nor in defending ourselves against the invasion of purely objective forces that threaten the dignity of the human subject. Humanism is to be located elsewhere, in the position I am groping to define between antihumanism and

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[11] After Marx, of course, see especially the classic argument by Langdon Winner, "Do Artefacts Have Politics?" *Daedalus* 109 (1980): 121–36.
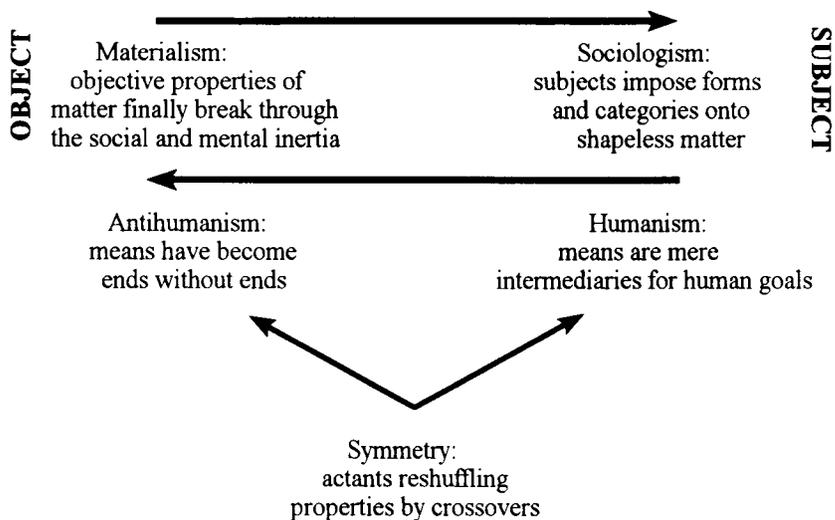
| OBJECT | Materialism:
objective properties of
matter finally break through
the social and mental inertia | Sociologism:
subjects impose forms
and categories onto
shapeless matter | SUBJECT |

Antihumanism: Humanism:
means have become   means are mere
ends without ends   intermediaries for human goals

Symmetry:
actants reshuffling
properties by crossovers

Fig. 5. New Locus for Humanism

"humanism." We must learn to ignore the definitive shapes of humans, and of the nonhumans with which we share more and more of our existence. The blur that we would then perceive, the swapping of properties, is a characteristic of our premodern past, in the good old days of *poesis,* and a characteristic of our modern and nonmodern present as well. One thing Heidegger got right is his critique of the "humanist" NRA story, of the notion that technologies and tools permit humans to hold their projects firmly in hand, to impose their will on objects.[12] But Heidegger added to the dangers of technology: he added the peril of ignoring how much humanity is swapped through the mediating role of techniques—and he added the peril of ignoring the function, genealogy, and history of those sociotechnical imbroglios (to which I now turn) that construct our political life and our fragile humanity.

SOCIOLOGY

Stanley Kubrick, in *2001: A Space Odyssey,* offers us a modern myth as powerful as that of Daedalus. Unidentified extraterrestrial minds have sent to the primeval earth a huge black box, a monolith, which a band of screaming monkeys now cautiously explore. The film does not indicate what the properties of the box are (apart from blackness— as opaque as the genealogy of techniques I am trying to fathom here), but the box has a mysterious effect on the apes. Is this because they are focusing their attention for the first time on an object or because of what this particular object contains? Whichever the case, they innovate, taking great strides in the direction of humanity. A huge bone

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[12]Bruno Latour, *We Have Never Been Modern,* trans. Catherine Porter (Cambridge: Harvard University Press, 1993).

lying at the water hole is suddenly seized by a rapidly evolving ape, transformed into a tomahawk, and used to break the skull of an enemy primate. (Tools and weapons, intelligence and war, commence all at once in this masculine myth.) The Promethean ape, thrilled by this invention and sudden change in the fortunes of war, launches the bone into the sky; the bone whirls around, then—again, suddenly—becomes a vast futuristic station, slowly turning on itself in the depth of space. From tools to high technology, millions of years are summarized in one beautiful cut.

Were scholarship as efficient as the art of film, I would have you progress as rapidly as Kubrick's apes—from a band of primates linked only by social ties to an evolved species of sociotechnical humans who admit their inferior brethren, the nonhumans, to their social thinking. But to bring this about would be quite a miracle, since social theory is as devoid of artifacts as were Kubrick's apes before the monolith arrived. Like the apes, it is on the monolith, precisely, that I will focus my attention: What is a sociology of objects? How did objects come to enter the human collective? Through which entry points? We now understand that techniques do not exist as such, that there is nothing that we can define philosophically or sociologically as an artifact or a piece of technology. To be sure, there is an adjective *technical* that we use in many different situations, and rightly so. Let me briefly summarize its various meanings.

It designates, first, a subprogram, or a series of nested subprograms, like the ones I discussed above. When we say "this is a technical point," it means that we have to deviate for a moment from the main task and that we will eventually resume our normal course of action, which is the only focus worth our attention. A black box opens momentarily, and will become black again, completely invisible in the main sequence of action.

Second, *technical* designates the subordinate role of people, skills, or objects that occupy this secondary function of being present, indispensable, but invisible. It thus indicates a specialized and highly circumscribed task, clearly subordinate in a hierarchy.

Third, the adjective designates a hitch, a snag, a catch, a hiccup in the smooth functioning of the subprograms, as when we say that "there is a technical problem to solve first." Here, the deviation might not lead us back to the main road, as with the first meaning, but may threaten the original goal entirely. *Technical* is no longer a mere detour, but an obstacle, a roadblock. What should have been a means, may become an end, at least for a while.

The fourth meaning carries with it the same uncertainty about what is an end and what is a means. "Technical skill," "technical personnel," designate a unique ability, a knack, a gift, and also the ability to make oneself indispensable, to occupy privileged though inferior positions that I have called, borrowing a military term, obligatory passage points. Technical people, objects, or skills are at once inferior (since the main

task will be resumed), indispensable (since the goal is unreachable without them), and, in a way, capricious, mysterious, uncertain (since they depend on some highly specialized and badly circumscribed knack). Daedalus the perverse, and Hephaistos the limping god, are good illustrations of the meaning of *technical*. So the adjective *technical* has a useful meaning that maps in the language the three first types of translation that I defined above.

Technical also designates a very specific type of delegation, of movement, of shifting, that crosses over with entities that have different timing, different properties, different ontologies, and that are made to share the same destiny, thus creating a new actant. Here the noun is often used as well as the adjective, as when we say "a technique of communication," "a technique for boiling eggs." In this case, the noun does not designate a thing, but a modus operandi, a chain of gestures and know-how, bringing about some anticipated result.

Let us compare two pipettes, that which Pasteur used a century ago and the automatic pipette in use today, the trademark of which is aptly "Pipetman." With a traditional pipette, I need to measure quantities precisely, by looking carefully through the transparent glass and checking the correspondence between the level of the liquid and the small calibrated measures engraved on the glass. Thus I need to take special care each time I dip the Pasteur pipette in the liquid before releasing it in another vessel. The calibration of the pipette is now standardized so that I may rely on the engraved measurements. The skills required of me by the new pipette are very different. With the Pipetman, I need only push twice with my thumb on the top of the instrument— once to take up the liquid and then again to release it—and turn the knobs at the top to set the amounts I want to take with each dipping. My point in comparing these two pipettes is that, although both require skills, the distribution of skills is different.[13] With the Pasteur pipette, I require a high degree of coordination and control for each new dipping; with the new pipette, I can rely, for this gesture at least, on force (once I have turned the knob). The new pipette is itself skilled—the program of action is now shared between an upskilled pipette and a relatively deskilled human pipetter.

Technical skill is not a thing we can study directly. We can only observe its dispersal among various types of actants. For instance, one could automate not only the uptake of liquid but its release, and there exist now in biological laboratories many pipetting robots. The total sum of activity—comparing my relation to the Pasteur pipette with my relation to the pipetting robot—is maintained or increased but its distribution has been modified. Some highly trained technicians are made redundant, unskilled workers are recruited, high-tech companies are created in order to produce robots where simple workshops were until recently sufficient. As Marx showed long ago,

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[13]Steven W. Allison, a molecular biologist at Cornell, pointed out to me that it requires, in fact, quite a lot of new skills to push and release the plunger. The real difference, according to him, is the precision obtained with the new pipette, which is one order of magnitude more precise than Pasteur's.

when we talk about something technical, we talk about displacement, conflicts, replacement, unskilling, deskilling, and reskilling; never about a mere "thing." Technical skill is not uniquely possessed by humans and reluctantly granted to nonhumans. Skills emerge in the zone of transaction, they are properties of the assembly that circulate or are redistributed among human and nonhuman technicians, enabling and authorizing them to act.

We must consider, then, who is mobilized by what kinds of action. Our first step is to look for the folding of time, which is a characteristic of technical action. *Once* I have bought the calibrated Pasteur pipette, I can *then* go on with my skilled task. *Once* I have turned the knobs of the automatic pipette, I can *then* fall back on a less skilled task. The enunciator, in other words, may absent itself. Even my own action of a moment ago is now foreign to me, though still present in a new guise. Through my productive detour, my investment, a relative irreversibility is set in place.

But we have also to recognize the role of economic mediation in the folding of time and space. Pasteur could have produced his pipette at the local glassblower's shop. I cannot manufacture an automatic pipette, still less a pipetting robot. Which means that, in the gesture of pushing on an instrument twice with my thumb, I take a long detour through the manufacturing process. Of course, the detour is invisible—except as an item on a long list of supplies I order out of grant monies—unless a crisis, either in my budget or in the pipette, occurs, or if I move my laboratory to Africa or to Bosnia, in which case I will come to realize that, in addition to the simple task of pushing twice with my thumb, pipetting requires that I ensure the reliability of an immense series of other actants. The question known as "the division of labor" may in no sense be differentiated from the question of what is technical.[14]

If ever one comes face to face with an object, that is not the beginning but the end of a long process of proliferating mediators, a process in which all relevant subprograms, nested one into another, meet in a "simple" task (e.g., pipetting). Instead of the kingdom of legend in which subjects meet objects, one generally finds oneself in the realm of the *personne morale,* of what is in English called the "corporate body" or "artificial person." Three extraordinary terms! As if the personality becomes moral by becoming collective, or collective by becoming artificial, or plural by doubling the Saxon word *body* with a Latin synonym, *corpus.* A body corporate is what the pipette and I, in my example, have become. We are an object-institution. The point sounds trivial if applied asymmetrically. "Of course," one might say, "a piece of technology must be seized and activated by a human subject, a purposeful agent." But the point I am making is symmetrical: What is true of the "object"—the pipette does not exist by itself—is still truer of the "subject." There is no sense in which humans may be said to exist as humans without entering into commerce with what authorizes and

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[14]Nevertheless, the classic work by Emile Durkheim, *The Division of Labor in Society,* trans. W. D. Halls (1893; New York: Free Press, 1984), does not mention techniques and artifacts at all.
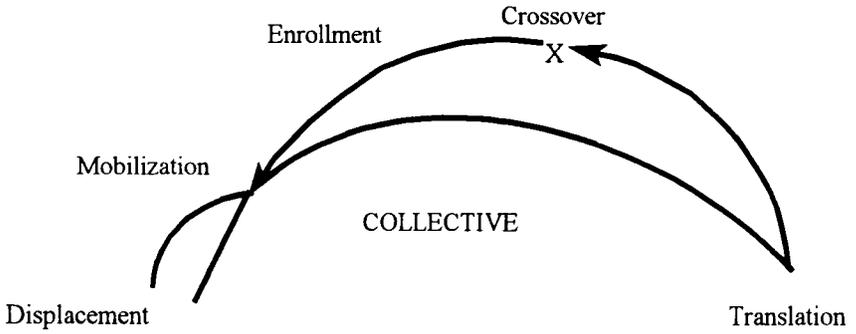
Fig. 6. The Entry Point of Nonhumans into the Collective

enables them to exist (i.e., to act). A forsaken pipette is a mere piece of matter, but what would an abandoned pipetter be? A human, yes (a pipette is only one artifact among many), but not a molecular biologist. Purposeful action and intentionality may not be properties of objects, but they are not properties of humans either. They are the properties of institutions, *dispositifs*. Only corporate bodies are able to absorb the proliferation of mediators, to regulate their expression, to redistribute skills, to require boxes to blacken and close. Boeing-747s do not fly, airlines fly.

Objects that exist simply as objects, finished, not part of a collective life, are unknown, buried under soil. Real objects are always parts of institutions, trembling in their mixed status as mediators, mobilizing faraway lands and people, ready to become people or things, not knowing if they are composed of one or of many, of a black box counting for one or of a labyrinth concealing multitudes. And this is why the philosophy of technology cannot go very far: an object is a subject that only sociology can study—a sociology, in any case, that is prepared to deal with nonhuman as well as human actants.

In the newly emerging paradigm (fig. 6), we substitute *collective*—defined as an exchange of human and nonhuman properties inside a corporate body—for the tainted word *society*. In abandoning dualism, our intent is not to abandon the very distinct features of the various parts within the collective. What the new paradigm attends to are the moves by which any given collective extends its social fabric to other entities. First, there is *translation,* the means by which we inscribe in a different matter features of our social order; next, the *crossover,* which consists in the exchange of properties among nonhumans; third, the *enrollment,* by which a nonhuman is seduced, manipulated, or induced into the collective; fourth, the *mobilization* of nonhumans inside the collective, which adds fresh unexpected resources, resulting in strange new hybrids; and, finally, *displacement,* the direction the collective takes once its shape, extent, and composition have been altered.

The new paradigm provides a basis for the comparison of collectives, a comparison that is completely independent of demography (of their scale, so to speak). What we students of science have all done over the last fifteen years is subvert the distinction between ancient techniques (the *poesis* of artisans) and modern (broad-scale, inhuman,

domineering) technologies. The distinction was never more than a prejudice. There is an extraordinary continuity, which historians and philosophers of technology have increasingly made legible, between nuclear plants, missile-guidance systems, computer-chip design, or subway automation and the ancient mixture of society and matter that ethnographers and archaeologists have studied for generations in the cultures of New Guinea, Old England, or sixteenth-century Burgundy.[15]

The difference between an ancient or "primitive" collective and a modern or "advanced" one is not that the former manifests a rich mixture of social and technical culture while the latter exhibits a technology devoid of ties with the social order. The difference, rather, is that the latter translates, crosses over, enrolls, and mobilizes *more elements*, more intimately connected, with a more finely woven social fabric than the former does. The relation between the *scale* of collectives and the *number* of nonhumans enlisted in their midst is crucial. One finds, of course, longer chains of action in "modern" collectives, a greater number of nonhumans (machines, automatons, devices) associated with one another, but one must not overlook the size of markets, the number of people in their orbits, the amplitude of the mobilization: more objects, yes, but many more subjects as well. Those who have tried to distinguish these two sorts of collective by attributing objectivity to modern technology and subjectivity to low-tech *poesis* were deeply mistaken. Objects and subjects are made simultaneously, and an increased number of subjects is directly related to the number of objects stirred—brewed—into the collective. The adjective *modern* does not describe an increased distance between society and technology or their alienation, but a deepened intimacy, a more intricate mesh, between the two: not *Homo faber* nor even *Homo faber fabricatus*, but *Homo faber socialis*.[16]

Ethnographers describe the complex relations implied by every technical act in traditional cultures, the long and mediated access to matter that these relations suppose, the intricate pattern of myths and rites necessary to produce the simplest adze or simplest pot, as if a variety of social graces and religious mores were necessary for humans to interact with nonhumans.[17] But do we, even today, have unmediated access to naked matter? Is our interaction with nature short on rites, myths, and protocols? To believe that would be to ignore most of the conclusions reached by modern sociologists of science and technology. How mediated, complicated, cautious, mannered, even baroque is the access to matter of any piece of technology! How many sciences—the

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[15]See, for instance, Donald A. MacKenzie, *Inventing Accuracy: An Historical Sociology of Nuclear Missile Guidance Systems* (Cambridge: MIT Press, 1990); Bijker and Law, eds., *Shaping Technology-Building Society*; Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch, eds., *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge: MIT Press, 1987).

[16]See Latour, *La clef de Berlin*.

[17]For a recent example, see Pierre Lemonnier, ed., *Technological Choices: Transformation in Material Cultures Since the Neolithic* (London: Routledge, 1993).

functional equivalent of rites—are necessary to prepare artifacts for socialization! How many persons, crafts, and institutions must be in place for the enrollment of even one nonhuman! The time has come for ethnographers to describe our biotechnology, artificial intelligence, microchips, steelmaking, etc.—the fraternity of ancient and modern collectives will then be instantly obvious. What appears symbolic in the old collectives is taken literally in the new; in contexts where a few dozen people were once required, thousands are now mobilized; where shortcuts were once possible, much longer chains of action are now necessary. Not fewer but more, and more intricate, customs and protocols, not fewer mediations but more: many more.

Aramis, an automated metro in the south of Paris, is a choice example of what I mean—a sleek piece of matter confronting the human subject (a passenger) ready to board it.[18] Aramis has no driver. The only human left in the system, the controller, can take over, by remote control, in the event the automatic equipment fails. The only "driver" is one of the six onboard computers. Aramis is a train without tracks and can turn at will like an automobile. The passenger has nothing to do, not even decide on the route to his destination. Aramis does it all. In other words, the ideal Frankenstein myth: a powerless human, boarding an automated train, far from traditional technologies and their rich sociotechnical mix.

But a few years ago, in July of 1985, what ethnographers and archaeologists never see was seen: a technology before it becomes an object or an institution, a technology when it is still a *project*. Aramis was a scale model, little more than a sketch. Assembled around its benign and futuristic shape were dignitaries, spokesmen for conflicting constituencies. A photograph at that time showed the director of the RATP, the Paris rapid-transit system, a communist in love with Aramis, symbol of modernization (though his own technicians are extremely skeptical about the feasibility of the system); then the president and vice-president of the Ile-de-France Region, two men on the right of the political spectrum with no special interest in Aramis as a symbol of anything (all they want is a transportation system, period, to decongest the south of Paris); then Charles Fiterman, Minister of Transportation, another communist—one of the three communists in the first government of President Mitterand (Fiterman is also preoccupied with modernization, with high tech, but lacks the expertise to evaluate the feasibility of the scale model and is anyway about to leave the government); and finally, Jean-Luc Lagardère, the flamboyant symbol of French high-tech capitalism and the builder of Aramis, closely involved with state technocracy, but deeply skeptical of the prospects for Aramis' technical success (he would prefer a simple automated subway like VAL in Lille, but is forced to embrace what Fiterman, the Minister, and Claude Quin, the director of the RATP, consider *the* French symbol of modernization).

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[18]On this example, see Bruno Latour, *Aramis, ou l'amour des techniques* (Paris: La Découverte, 1992), forthcoming from Harvard University Press, trans. Catherine Porter. For a briefer presentation, see Bruno Latour, "Ethnography of a 'High-Tech' Case: About Aramis," in Lemonnier, *Technological Choices,* 372–98.

For two years, the dignitaries have discussed the project, which has been under way for fifteen. They have assembled to sign the contract for the final industrial test of Aramis.

Looking at a project before it is an object, one sees not only the people who inhabit it but also the translation they wish to effect: five spokesmen, five versions of Aramis converging on a scale model whose task is to reconcile their notions of what is politically valuable, technically feasible, efficient, expedient, and profitable. But what of the myth of technology, the Frankensteinian autonomy of design? M. Lagardère, captain of industry, wants a semitraditional subway like the VAL but is obliged to press his engineers for a hypersophisticated system to please the communists—who are worried about a possible strike of the drivers' union against automation and thus want a system that looks as different from a subway as possible. Aramis swallows the contradictory wishes of all involved, absorbs them, and becomes knotted, self-contradictory, and labyrinthine.

Aramis did not exist *enough*. Technical systems have many intermediary degrees of realization. Not long before transporting Jacques Chirac, the former prime minister, Aramis was a construction site in the south of Paris; three or four years after, a home for destitutes; then a sleek cabin in the Museum of Transportation. Aramis ceased to exist. Not one real passenger ever boarded it. From a project it became not an object but a fiction. And even if it had at some point existed as a transportation system, Aramis would have been not an object but an institution, a corporate body including passengers, engineers, controllers, and many nonhumans, all safely "black boxed." The moral of this tale is not that the more advanced technology becomes, the less (and fewer) people have to do with it. On the contrary, in order to move from fiction to project, from project to trial, and from trial to transportation system, ever more people are required. It is because so many abandoned Aramis that it began to cease existing and reversed course: from trial to project, from project to fiction, and from fiction to utopia, the utopia of Personal Rapid Transit that some American cities, blissfully ignorant of Aramis' fate, are now taking up again.

The new paradigm is not without its problems. To view people and nonhumans as interacting within collectives, to define objects as institutions, to fuse subject and object in a corporate body, we need to know what a collective, an institution, and a corporate body are. The difficulty is that we cannot rely on how social theory defines these, since, for many sociologists, a social order is the source of explanation and not what needs explaining. These sociologists begin by delineating social phenomena, long-term social contexts, global institutions, overarching cultures; then proceed with what they take to be their important empirical task, to trace developments and transformations. It is a given, for them, that social order exists. The question of how social order emerges has been abandoned to political philosophy, to the prescientific past out of which Durkheim's descendants have escaped. We are, like the bull dancers of Minos,

on the horns of a dilemma: social theory is the way beyond the limits of the philosophy of techniques, but social theorists tell us that the emergence of social order is but a philosophical myth. The definition of social context by the social sciences is of little help since it does not include the nonhumans' role. What social scientists call society represents half of the dualist paradigm that should be jettisoned. A "society" is not the same as the "collective" I am trying to define. Hence, in order to understand technical mediation, we also have to redefine a large part of social theory, bringing back into it, I am afraid, many philosophical questions that it has tried to dispense with too quickly.

Our task, fortunately, is made easier by a radical movement in sociology whose real import and impact has yet to be felt in the study of technology and that is called, rather horribly, "ethnomethodology." What this movement does is take seriously the innocuous assumption that people construct society. Social order, the ethnomethodologists argue, is not a given, but the result of an ongoing practice through which actors, in the course of their interaction, elaborate ad hoc rules to coordinate activities. The actors are helped of course by precedents, but those precedents are not in themselves sufficient to cause behavior, and they are translated, adjusted, reconfigured, invented (in part) to make do in view of shifting and unexpected circumstances. We collectively elaborate an emerging and historical *event* which was not planned by any participant and which is not explainable by what happened before the event or what happens elsewhere. All depends on the local and practical interactions in which we are presently engaging.

The theory seems absurd in view of the claim most reasonable sociologists and historians would make about, for instance, our present circumstance: There exists a broad-scale context that accounts for my writing and your reading this article, for our knowledge of what a scholarly article is, what a journal does, what role intellectuals play in America and France. At most, the reasonable sociologist tells the radical one, the agent can make local adjustments in a context long since and faraway established. So runs the thirty-year debate between ethnomethodology and mainstream sociology, and the still older dispute between agency and structure.

The new paradigm I am proposing for the study of techniques obviates these disputes. Let us admit that the ethnomethodologists are right, that there exist only local interactions, producing social order on the spot. And let us admit that mainstream sociologists are right, that actions at a distance may be transported to bear on local interactions. How can these positions be reconciled? An action in the distant past, in a faraway place, by actors now absent, can still be present, on condition that it be shifted, translated, delegated, or displaced to other types of actants, those I have been calling nonhumans. My word processor, your copy of *Common Knowledge*. Oxford University Press, the International Postal Union, all of them organize, shape, and limit our interactions. To forget their existence—their peculiar manner of being absent and present—would be a great error. When we say that "we" here present are engaged in our local interactions, the sum of those who are summoned must include all the other

personae that have been shifted down previously. "We" is not a simple synoptic and coherent category. The notion of a present and local interaction is subverted by an immense crowd of nonhumans, each determined by its own shifts in time, space, and actant.

But to infer, from the conclusion that we are not alone in our interactions, the existence of an overarching society would be an equally great mistake, since it would oblige us to shift attention from the micro to the macro level, as if the macro level existed and was made of other stuff, of material other than the present local interaction. The dispute about the respective role of agency and structure, of "habitus" and "field" (to use Bourdieu's formula), of micro interaction and macro social context, reveals, by its very failure, the presence-absence of technical mediation. Of course, ethnomethodologists are right to criticize traditional sociology with its fanciful macro level, but they are wrong to conclude that there is such a thing as an absolutely local interaction. No human relationship exists in a framework homogeneous as to space, time, and actants. However, the error that traditional sociology makes is as great, when it forgets to ask how a difference of scale is obtained, how power is exerted, irreversibility sets in, and roles and functions are distributed. Everything in the definition of macro social order is due to the enrollment of nonhumans—that is, to technical mediation. Even the simple effect of duration, of long-lasting social force, cannot be obtained without the durability of nonhumans to which human local interactions have been shifted.

The social theory of techniques overhauls sociology, even as it repairs the weaknesses of ethnomethodology. Society is the outcome of local construction, but we are not alone at the construction site, since there we also mobilize the many nonhumans through which the order of space and time has been reshuffled. To be human requires sharing with nonhumans. Social theory may be better at the task of defining what is human than philosophy is, but only when and insofar as it accounts for social complexity, the invention of tools, and the sudden appearance of the black box. I am thinking, still, of Stanley Kubrick, his daring cut that transformed a whirling tomahawk into a silent space station, turning slowly in the depth of space, but I would like, of course, to dispense with an appeal to any extraterrestrial benefactor.

GENEALOGY[19]

11 A.M.: Clairborne sits near Niva, looking around vigilantly. Before Clairborne can make a move, Crook arrives, very nervous. Both Clairborne and Crook want Niva's favors, but Clairborne is her old friend. Crook has just arrived in the group and is so unpredictable that no one trusts him. Clairborne moves toward Niva, but this does

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[19]An earlier version of the following has been published in a special issue of *American Behavioral Scientist*, 37 (1994): 791–808, under the title "Pragmatogonies . . . A Mythical Account of How Humans and Non-Humans Swap Properties."

not stop Crook, who continues to close in. Tension mounts. Niva is caught between conflicting emotions, wanting to flee, yet worried to be on her own so near Crook. She opts to stay near Clairborne, which seems the safer bet. The others watch carefully to see what will happen. Sharman pays special attention since the outcome could affect him. Crook lunges at Clairborne but, instead of running away, Clairborne grabs Niva's infant. The infant clings trustingly to its big friend. Suddenly the action shifts, as if Clairborne had erected a protective shield around himself and Niva. Frustrated, but not daring to make a further move toward them, Crook turns elsewhere to vent his frustration. As he suspected, Sharman becomes the target of Crook's aggression. The two run off exchanging threats, and the small group around Niva relaxes. Clairborne huddles closer to Niva; the infant snuggles in her lap. Now it is Sharman who has the problem. It is 11:05 A.M.

This bit of soap opera does not come from *Dallas* or any of the other programs with which Americans conquer television sets around the world, but from Shirley Strum's study of baboons in Kenya. I want to begin the third part of this discussion not with a technical myth like that of Daedalus or like that of Kubrick's *2001*, but with this exemplary study of a nontechnical but highly complex society. This group of baboons, called Pump-House, which had the good fortune to be studied for twenty years by Strum, offers the best baseline, the best benchmark, to register what we mean by techniques, since, although the social and political maneuvering of baboons is complex, they are, as distinct from chimpanzees, for instance, devoid of tools and artifacts, at least in the wild.[20]

What do human collectives have that those socially complex baboons do not possess? Technical mediation—which we are now prepared to summarize: Technical action is a form of delegation that allows us to mobilize, during interactions, moves made elsewhere, earlier, by other actants. It is the presence of the past and distant, the presence of nonhuman characters, that frees us, precisely, from interactions (what we manage to do, right away, with our humble social skills). That we are not Machiavellian baboons we owe to technical action. To say this, however, entails no *Homo faber* mythology: techniques provide no sort of privileged, unmediated, unsocialized access to objective matter and natural forces. "Objects," "matter," "force," and "nature" are very late comers and cannot be used as starting points. The traditional definition of technique as

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[20]The above passage on baboon behavior is based on conversation during 1994 with Shirley Strum. See also her book, *Almost Human: A Journey into the World of Baboons* (New York: Random House, 1987); and Bruno Latour and Shirley Strum, "Human Social Origins: Please Tell Us Another Origin Story!" *Journal of Biological and Social Structures* 9 (1986): 169–87; Shirley Strum and Bruno Latour, "The Meanings of Social: From Baboons to Humans," *Information sur les sciences sociales/Social Science Information* 26 (1987): 783–802. The section of this article titled "Genealogy" is a continuation of our collaborative work. See also Bijker and Law, *Shaping Technology-Building Society*; Latour, *We Have Never Been Modern*; MacKenzie, *Inventing Accuracy*; Lemonnier, *Technological Choices*.

the imposition of a form consciously planned onto shapeless matter should be replaced by a view of technique—a more accurate view—as the socialization of nonhumans.

The most important consequence of criticizing the *Homo faber* myth is that, when we exchange properties with nonhumans through technical delegation, we enter into a complex transaction that pertains to "modern" as well as traditional collectives. If anything, the modern collective is that in which the relations of human and nonhuman are so intimate, the transactions so many, the mediations so convoluted, that there is no plausible sense in which artifact, corporate body, and subject can be distinguished. In order to take account of this symmetry between humans and nonhumans, on the one hand, and this continuity between traditional and modern collectives, on the other, social theory must be somewhat modified. It is a commonplace, in critical theory, to say that techniques are social because they have been socially constructed. But this pronouncement is vacuous if the meanings of *mediation* and *social* are not made precise. To say that social relations are "inscribed" in technology, such that when we are confronted with an artifact, we are confronted, in effect, with social relations, is to assert a tautology, a very implausible one. If artifacts are social relations, then why must society work through them to inscribe itself in something else? Why not inscribe itself directly, since the artifacts count for nothing? By working through the medium of artifacts, domination and exclusion hide themselves under the guise of natural and objective forces: critical theory thus deploys a tautology—social relations are nothing but social relations—then it adds to it a conspiracy theory—society is hiding behind the fetish of techniques.

But techniques are not fetishes, they are unpredictable, not means but mediators, means and ends at the same time; and that is why they bear on the social fabric. Critical theory is unable to explain why artifacts enter the stream of our relations, why we so constantly recruit and socialize nonhumans. It is not to mirror, inscribe, or hide social relations, but to remake them through fresh and unexpected sources of power. Society is not stable enough to inscribe itself in anything. On the contrary, most of the features of what we mean by social order—scale, asymmetry, durability, power, hierarchy, the distribution of roles—are impossible even to define without recruiting socialized nonhumans. Yes, society is constructed, but not *socially* constructed. Only the Machiavellian baboon, the Kubrick ape, constructs its society socially. Humans, for millions of years, have extended their social relations to other actants with which, with whom, they have swapped many properties, and with which, with whom, they form *collectives.*

But is symmetry between humans and nonhumans really possible? Do not humans always have the initiative? This commonsense objection is not commonsensical, since in most of our activities we do not attribute a causative role to humans. Scientists, for instance, like to claim that they do not speak, that nature speaks (or, more precisely, writes) through the medium of the laboratory and its instruments. It is reality, in other words, that does most of the talking. We find the same conundrum in political theory

(Hobbes's Sovereign acts, but the People write the script) and also in fiction (novelists like to say they are forced to write by the Muse or by the sheer impulse of their characters), while many historians and critics appeal to still another collective force for which novelists play the expressive role of medium, that of society or that of zeitgeist. A second glance at any activity undermines the easy, commonsense idea that humans speak and act. Every activity implies the principle of symmetry between humans and nonhumans or, at the least, offers a contradictory mythology that disputes the unique position of humans. The same uncertainty bedevils techniques, which are human actions that end up being actions of nonhumans. Responsibility for action must be shared, symmetry restored, and humanity redescribed: not as the sole transcendent cause, but as the mediating mediator.

A detailed case study of sociotechnical networks ought to follow at this juncture, but many such studies have already been written, and most have failed to make their new social theory felt. These studies are understood by readers as catalogue examples of the "social construction" of technology. Readers account for the evidence mustered in them with reference to the dualist paradigm that the studies themselves tend to undermine. The obstinate devotion to "social construction" as an explanatory device seems to derive from the difficulty of disentangling the various meanings of the catchword *sociotechnical*. What needs to be done, then, is to peel away, one by one, the layers of meaning and attempt a genealogy of their associations. Moreover, having disputed the dualist paradigm for years, I have come to realize that no one is prepared to abandon an arbitrary but useful dichotomy, such as that between society and technology, if it is not replaced by categories that have at least the same discriminating power as the one jettisoned. We can toss around the phrase "sociotechnical networks" forever without moving beyond the dualist paradigm that we wish to overcome. To move forward, I must convince you that one can discriminate much finer details using the new paradigm, which blurs the distinction between social actors and objects. This in turn requires that I begin from the most contemporary meanings and move down to the most primitive. Each meaning could be loosely defined as sociotechnical, but the novelty is that I will be able in the future to qualify with some precision which sort of properties are swapped or invented at each level of meaning.

For my present story, I have isolated eleven distinct layers. Of course, I do not claim for these definitions, nor for their sequence, any plausibility. I simply want to show that the tyranny of the dichotomy between humans and nonhumans is not inevitable, since it is possible to envision another myth in which it plays no role. If I succeed in opening some space for the imagination, then we are not forever stuck with the boring alternation of humans to nonhumans, and back. It should be possible to imagine a space, that could be studied empirically, in which we could observe the swapping of properties without having to start from a priori definitions of humanity.

Political Ecology (Level 11)

The eleventh interpretation of the crossover—the swapping of properties—between humans and nonhumans is the simplest to define because it is the most literal. Lawyers, activists, ecologists, businessmen, political philosophers are now seriously talking, in the context of our ecological crisis, of granting to nonhumans some sort of rights and even standing in court. Not so many years ago, contemplating the sky meant thinking of matter, or of nature. These days, we look up at a sociopolitical imbroglio, since the depletion of the ozone layer brings together a scientific controversy, a political dispute between North and South, and immense strategic changes in industry. Political representation of nonhumans seems not only plausible now, but necessary, when the notion would have seemed ludicrous or indecent not long ago. We used to deride primitive peoples who imagined that a disorder in society, a pollution, could threaten the natural order. We no longer laugh so heartily, as we abstain from using aerosols for fear the sky may fall on our heads. Like the primitives, we fear the pollution caused by our negligence.

As with all crossovers, all exchanges, this one mixes elements of both sides, the political with the scientific and technological in this case, and the mixing is not a haphazard rearrangement. Technologies have taught us how to manage vast assemblies of nonhumans; our newest sociotechnical hybrid brings what we have thus learned to bear on the political system. The new hybrid remains a nonhuman, but not only has it lost its material and objective character, it has acquired properties of citizenship. It has, for instance, the right not to be enslaved. This first layer of meaning—the last in chronological sequence to arrive—is that of political ecology or, to use Michel Serres' term, "the natural contract."[21] We have literally, not symbolically as before, to manage the planet we inhabit, and must now define a politics of things.

Technologies (Level 10)

Talk of a crossover between technology and politics does not, in the present myth (or pragmatogony), indicate belief in the distinction between a material realm and a social one. I am simply unpacking the eleventh layer of what is packed in the definitions of society and technique. If I descend to the tenth layer, I see that our definition of technology is itself due to the crossover between a previous definition of society and a particular version of what a nonhuman can be. To illustrate: some time ago, at the Institut Pasteur, a scientist introduced himself, "Hi, I am the coordinator of yeast chromosome 11." The hybrid whose hand I shook was, all at once, a person (he called

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[21] Michel Serres, *Le contrat naturel* (Paris: Bourin, 1990); Michel Serres, *Eclaircissements: Cinq entretiens avec Bruno Latour* (Paris: Bourin, 1992).

himself "I"), a corporate body ("the coordinator"), and a natural phenomenon (the genome, the DNA sequence, of yeast). The dualist paradigm will not aid in understanding this hybrid. Place its social aspect on one side, and yeast DNA on the other, and you will bungle not only the data but also the opportunity to grasp how a genome becomes known to an organization and how an organization is naturalized in a DNA sequence on a hard disk.

We again encounter a crossover here, but it is of a different sort and goes in a different direction, although it could also be called sociotechnical. For the scientist I interviewed, there is no question of granting any sort of rights, of citizenship, to yeast. For him, yeast is a strictly material entity. Still, the industrial laboratory where he works is a place in which new modes of organization of labor elicit completely new features in nonhumans. Yeast has been put to work for millennia, of course, for instance in the old brewing industry, but now it works for a network of thirty European laboratories where its genome is mapped, humanized, and socialized, as a code, a book, a program of action, compatible with our ways of coding, counting, and reading, retaining little of its material quality. It is absorbed into the collective. Through technology—defined, in the anglophone sense, as a fusion of science, organization, and industry—the forms of coordination learned through "networks of power" (see below) are extended to disarticulate entities. Nonhumans are endowed with speech, however primitive, with intelligence, foresight, self-control, and discipline, in a fashion both large-scale and intimate. Social-ness is shared with nonhumans in an almost promiscuous way. While on this model (the tenth meaning of *sociotechnical*), automata have no rights, they are much more than material entities; they are complex organizations.

Networks of Power (Level 9)

Organizations, however, are not purely social, because they themselves recapitulate nine prior crossovers of humans and nonhumans. Alfred Chandler and Thomas Hughes have each traced the interpenetration of technical and social factors in what Chandler terms the "global corporation" and Hughes terms "networks of power."[22] Here again, the phrase "sociotechnical imbroglio" would be apt, and one could replace the dualist paradigm by the "seamless web" of technical and social factors so beautifully deployed by Hughes. But the point of my little genealogy is also to identify, inside the seamless web, properties borrowed from the social world in order to socialize nonhumans, and, vice versa, borrowed from nonhumans in order to naturalize and expand the social realm. For each layer of meaning, whatever happens happens as if we were learning, in

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[22]Alfred D. Chandler, *Scale and Scope: The Dynamics of Industrial Capitalism* (Cambridge: Harvard University Press, 1990); Thomas P. Hughes, *Networks of Power: Electric Supply Systems in the US, England and Germany, 1880–1930* (Baltimore: Johns Hopkins University Press, 1983).
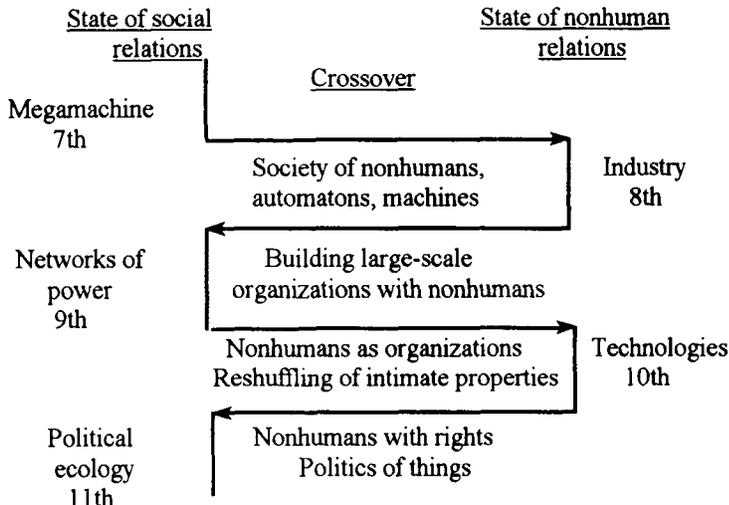
Fig. 7. Five Successive Meaning of Sociotechnical

contact with one side, ontological properties that are then reimported to the other side, generating new, completely unexpected effects (Fig. 7).

The extension of networks of power in the electrical industry, in telecommunications, in transportation, is impossible to imagine without a massive mobilization of material entities. Hughes's book is exemplary for students of technology because it shows how a technical invention (electrical lighting) led to the establishment (by Edison) of a corporation of unprecedented scale, its scope directly related to the physical properties of electrical networks. Not that Hughes in any way talks of infrastructure triggering changes in superstructure; on the contrary, his networks of power are complete hybrids, though hybrids of a peculiar sort—they lend their nonhuman qualities to what were until then weak, local, and scattered corporate bodies. Management of large masses of electrons, clients, power stations, subsidiaries, meters, and dispatching rooms acquires the formal and universal character of scientific laws.

This ninth layer of meaning resembles the eleventh, with which we began, since in both cases the crossover is from nonhumans to corporate bodies. (What can be done with electrons can be done with electors.) But the intimacy of human and nonhuman is less apparent in networks of power than in political ecology. Edison, Bell, and Ford mobilized entities that looked like matter, that seemed nonsocial, whereas political ecology involves the fate of nonhumans already socialized, so closely related to us that they have to be protected by delineation of their legal rights.

Industry (Level 8)

Even philosophers and sociologists of techniques tend to imagine that there is no difficulty in defining material entities because they are objective, unproblematically com-

posed of forces, elements, atoms. Only the social, the human realm is difficult to interpret, we often believe, because it is complexly historical. But whenever we talk of matter, we are really considering, as I am trying to show here, a package of former crossovers between social and natural elements, so that what we take to be primitive and pure terms are belated and mixed ones. Already we have seen that matter varies greatly from layer to layer—matter in the layer I have called "political ecology" differs from that in the layers called "technology" and "networks of power." Far from being primitive, immutable, and ahistorical, matter has a complex genealogy.

The extraordinary feat of what I will call *industry* is to extend to matter a further property that we think of as exclusively social, the capacity to relate to others of one's kind. Nonhumans have this capacity when part of the assembly of actants that we call a machine: an automaton endowed with autonomy of some sort and submitted to regular laws that can be measured with instruments and accounting procedures. From tools held in the hands of human workers, the shift historically was to assemblies of machines, where tools *relate to one another*, creating a massive array of labor and material relations in factories that Marx described as so many circles of hell. The paradox of this stage of relations between humans and nonhumans is that it has been termed "alienation," dehumanization, as if it were the first time that poor and exploited human weakness was confronted with an all-powerful objective force. However, to relate nonhumans together in an assembly of machines, ruled by laws, and accounted for by instruments, is to grant them a sort of social life. Indeed, the modernist project consists in creating that peculiar hybrid: a fabricated nonhuman that has nothing of the character of society and politics yet builds the body politic all the more effectively because it seems completely estranged from humanity.[23] This famous shapeless matter, celebrated so fervently throughout the eighteenth and nineteenth centuries, which is there for Man's—but not Woman's—ingenuity to mould and fashion, is only one of many ways to socialize nonhumans. They have been socialized to such an extent that they now have the capacity of creating an assembly of their own, an automaton, checking and surveying, pushing and triggering other automata, as if with full autonomy. The "megamachine" (see below) has been extended to nonhumans.

It is only because we have not undertaken an anthropology of our modern world that we can overlook the strange and hybrid quality of matter as it is seized on and implemented by industry. We take matter as mechanistic, forgetting that mechanism is one-half the modern definition of society. A society of machines? Yes, the eighth meaning of the word *sociotechnical*, though it seems to designate an unproblematic industry, dominating matter through machinery, is the strangest sociotechnical imbroglio. Matter is not a given, but a recent historical creation.

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[23]Latour, *We Have Never Been Modern*.

The Megamachine (Level 7)

But where does industry come from? It is neither a given nor the sudden discovery by capitalism of the objective laws of matter. We have to imagine its genealogy through earlier and more primitive meanings of the term *sociotechnical*. Lewis Mumford has made the intriguing suggestion that the *megamachine*—the organization of large numbers of humans via chains of command, deliberate planning, and accounting procedures—represents a change of scale that had to be made before wheels and gears could be developed.[24] At some point in history, human interactions come to be mediated through a large stratified, externalized body politic that keeps track, employing a range of "intellectual techniques" (writing and counting, basically), of the many nested subprograms of action. By replacing some, though not all, of these subprograms with nonhumans, machinery and factories are born. The nonhumans, in this view, enter an organization that is already in place and take on a role rehearsed for centuries by obedient human servants enrolled in the imperial megamachine.

In this seventh episode, the mass of nonhumans assembled in cities by an internalized ecology—I will define this expression shortly—has been brought to bear on empire building. Mumford's hypothesis is debatable, to say the least, when our context of discussion is the history of technology; but the hypothesis makes excellent sense in the context of my genealogy. Before it is possible to delegate action to nonhumans, and possible to relate nonhumans to one another in an automaton, it must first be possible to nest a range of subprograms for action into one another without losing track of them. Management, Mumford would say, precedes the expansion of material techniques. More in keeping with the logic of my story, one might say that whenever we learn something about the management of humans, we shift that knowledge to nonhumans and endow them with more and more organizational properties. The even-numbered episodes I have recounted so far follow this pattern: industry shifts to nonhumans the management of people learned in the imperial machine, much as technologies shift to nonhumans the large-scale management learned through networks of power. In the odd-numbered episodes, the opposite process is at work: what has been learned from nonhumans is reimported so as to reconfigure people.

Internalized Ecology (Level 6)

In the context of layer seven, the megamachine seems a pure and even final form, comprised entirely of social relations; but, as we reach layer six and examine what underlies the megamachine, we find the most extraordinary extension of social rela-

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[24] Lewis Mumford, *The Myth of the Machine: Technics and Human Development* (New York: Harcourt, Brace & World, 1966).

tions to nonhumans: agriculture and the domestication of animals. The intense social-ization, reeducation, and reconfiguration of plants and animals—so intense that they change shape, function, and often genetic makeup—is what I mean by the term *inter-nalized ecology*. As with our other even-numbered episodes, domestication cannot be described as a sudden access to an objective material realm that exists beyond the social. In order to enroll animals, plants, proteins in the emerging collective, one must first endow them with the social characteristics necessary for their integration. This shift of characteristics results in a man-made landscape for society (villages and cities) that completely alters what was until then meant by social and material life. In de-scribing layer six, we may speak of urban life, empires, and organizations, but not of society and/versus techniques—nor of symbolic representation and/versus infrastruc-ture. So profound are the changes entailed at this level that we pass beyond the gates of history and enter more profoundly those of prehistory, of mythology.

Society (Level 5)

What is a *society*, the beginning of all social explanations, the given of social science? If my pragmatogony is even vaguely suggestive, *society* cannot be part of our final vo-cabulary, since the term had itself to be made, "socially constructed" as the misleading expression goes. But in the Durkheimian interpretation, a society is final indeed: it precedes individual action, lasts very much longer than any interaction does, domi-nates our lives—*is that in which* we are born, live, and die. It is externalized, reified, more real than ourselves, hence the origin of all religion and sacred ritual, which, for Durkheim, are nothing but the return, through figuration and myth, of what is transcendent to individual interactions.

And yet society itself is constructed only through such quotidian interactions. However advanced, differentiated, and disciplined society becomes, we still repair the social fabric out of our own, immanent knowledge and methods. Durkheim may be right, but so is Garfinkel. Perhaps the solution, as according to the reproductive prin-ciple of my genealogy, is to look for nonhumans. (The principle: Look for nonhumans when the emergence of a social feature is inexplicable; look to the state of social rela-tions when a new and inexplicable type of object enters the collective.) What Durk-heim mistook for the effect of a sui generis social order is simply the effect of having brought so many techniques to bear on our social relations. It was from techniques that we learned what it means to subsist and distend, to accept a role and discharge a function. By reimporting this competence into the definition of society, we taught ourselves to reify it, to make society stand independent of fast-moving interactions. We even learned how to delegate to society the task of relegating us to roles and func-tions. Society exists, in other words, but is not socially constructed. Nonhumans prolif-erate below the bottom line of social theory.

Techniques (Level 4)

By this stage in our speculative genealogy, we can no longer talk of humans, of anatomically modern humans, but only of social *pre*humans. At last, we are in a position to define *technique* with some precision. Techniques, we learn from archaeologists, are articulated subprograms for actions that subsist (in time) and extend (in space). Techniques imply not society (that late-developing hybrid) but a semisocial organization that brings together nonhumans from very different seasons, places, and materials. A bow and arrow, a javelin, a hammer, a net, an article of clothing are composed of parts and pieces that require recombination in sequences of time and space that bear no relation to their natural settings. Techniques are what happen to tools and nonhuman actants when processed through an organization that extracts, recombines, and socializes them. Even the simplest techniques are sociotechnical; even at this primitive level of meaning, forms of organization are inseparable from technical gestures.

Social Complication (Level 3)

But *what* form of organization can explain these recombinations? Recall that at this stage there is no society, no overarching framework, no dispatcher of roles and functions; merely interactions among prehumans. Shirley Strum and I term this third layer of meaning *social complication.*[25] Complex interactions are now marked and followed by nonhumans enrolled for the purpose. Why? Nonhumans stabilize social negotiations. Nonhumans are at once pliable and durable; they can be shaped very quickly but, once shaped, last far longer than the interactions that fabricated them. Social interactions are extremely labile and transitory. More precisely, either they are negotiable but transient or, if they are encoded (for instance) in the genetic makeup, they are extremely durable but difficult to renegotiate. By involving nonhumans, the contradiction between durability and negotiability is resolved. It becomes possible to follow (or "black box") interactions, to recombine highly complicated tasks, to nest subprograms into one another. What was impossible for complex social animals to accomplish becomes possible for prehumans—who use tools, not to acquire food but to fix, underline, materialize, and keep track of the social realm. Though composed only of interactions, the social realm becomes visible and attains through the enlistment of nonhumans—tools—some measure of durability.

The Basic Tool Kit (Level 2)

The tools themselves, wherever they came from, are our only witnesses for hundreds of thousands of years. Many archaeologists proceed on the assumption that the *basic*

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[25]Strum and Latour, "The Meanings of Social."

tool kit (as I call it) and techniques are directly related by an evolution of tools into composite tools. But there is no direct route from flints to nuclear-power plants. Further, there is no direct route, as many social theorists presume there to be, from social complication to society, megamachines, networks. Finally, there is not a set of parallel histories, the history of infrastructure and the history of superstructure, but only one sociotechnical history.

What, then, is a tool? The extension of social skills to nonhumans. Machiavellian monkeys and apes, such as those introduced at the beginning of this section, possess little by way of techniques, but can devise (as Hans Kummer has shown) *social tools* through complex strategies of manipulating and modifying one another.[26] If you grant the prehumans of my own mythology the same kind of social complexity, you grant as well that they may generate tools by shifting that competence to nonhumans, by treating a stone, say, as a social partner, modifying it, then acting on a second stone. Prehuman tools, in contrast to the ad hoc implements of other primates, represent the extension of a skill rehearsed in the realm of social interactions.

Social Complexity (Level 1)

We have finally reached the level of Clairborne, Niva, and Crook, the Machiavellian primates. Here they engage in Garfinkelian interactions to repair a constantly decaying social order. They manipulate each another to survive in groups, each group of conspecifics in a state of constant mutual interference. We call this state, this level, *social complexity.*[27] I will leave it to the ample literature of primatology to show that this stage is no purer from contact with tools and techniques than any of the later stages. Instead I will reconsider the entire genealogy, this seemingly dialectical history that does not rely on dialectical movement. It is crucial to reiterate that the contradiction of object and subject is not the engine of its plot. Even if the speculative theory I have outlined is entirely false, it shows, at the very least, the possibility of imagining a genealogical alternative to the dualist paradigm. We are not forever trapped in a boring alternation between objects or matter and subjects or symbols. We are not limited to "not only . . . but also" explanations. My little origin myth makes conceivable the impossibility of an artifact that does not incorporate social relations, and makes conceivable the impossibility of defining social structures without accounting for the large role of nonhumans in them.

Second, and more importantly, the genealogy demonstrates that it is false to claim, as so many do, that once we abandon the dichotomy between society and techniques, we are faced with a seamless web of factors in which all is included in all. On the

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[26] Hans Kummer. *Vies de singes: Moeurs et structures sociales des babouins hamadryas* (Paris: Odile Jacob, 1993).

[27] Strum and Latour, "The Meanings of Social."

State of social relations	Crossover	State of nonhuman relations	
1st	Social Com-plexity	social tools		
		pliability durability	Basic Tool Kit	2nd
3rd	Social Com-plication	articulation		
		externalization	Techniques	4th
5th	Society	domestication		
		reification	Internalized Ecology	6th
7th	Megamachine	large-scale management		
		automaton	Industry	8th
9th	Networks of Power	extension rearticulation		
		objects institutions	Technologies	10th
11th	Political Ecology	politics of nature		

"SOCIETY"   "TECHNIQUES"

Fig. 8. A Mythical Alternative to the Dualist Paradigm

contrary, the properties of humans and nonhumans cannot be swapped haphazardly. Not only is there an order in the exchange of properties, but for each of the layers I have peeled away, the meaning of the word *sociotechnical* is clarified by considering the exchange: what has been learned from nonhumans and reimported into the social realm, what has been rehearsed in the social realm and exported back to the nonhumans. Nonhumans too have a history. They are not material objects or constraints. Sociotechnical$_1$ is different from sociotechnical$_6$ or $_8$ or $_{11}$. By adding subscripts, we are able to *qualify* the meanings of a term that until now has been hopelessly confused. In place of the great vertical dichotomy between society and techniques, there is conceivable (in fact, now, available) a range of horizontal distinctions between very various meanings of the sociotechnical hybrids. It is possible to have our cake and eat it—to be monists *and* make distinctions.

All this is not to claim that the old dualism, the prior paradigm, had nothing to say

for itself. We have indeed to alternate between states of social and states of nonhuman relations, but this is not the same as alternating between humanity and objectivity. The mistake of the dualist paradigm was its definition of humanity. Even the shape of humans, our very body, is composed in large part of sociotechnical negotiations and artifacts. To conceive humanity and technology as polar is to wish away humanity: we are sociotechnical animals, and each human interaction is sociotechnical. We are never limited to social ties. We are never faced with objects. This final diagram (fig. 8) relocates humanity where we belong—in the crossover, the central column, the possibility of mediating between mediators.

At each of the eleven episodes I have retraced, an increasingly large number of humans is mixed with an increasingly large number of nonhumans, to the point where, today, the whole planet is engaged in the making of politics, law, and soon, I suspect, morality. The illusion of modernity was to believe that the more we grow, the more distant objectivity and subjectivity would become, thus creating a future radically different from our past. After the paradigm shift in our conception of science and technology, we now know that this will never be the case, indeed that this has never been the case. Objectivity and subjectivity are not opposed, they grow together, and they grow irreversibly together. The challenge to our philosophy, social theory, and morality is to invent political institutions that can absorb this much history, this huge spiralling movement, this destiny, this fate. . . . At the very least, I hope to have convinced you that, if our challenge is to be met, it will not be met by considering artifacts as things. They deserve better. They deserve to be housed in our intellectual culture as full-fledged social actors.

They mediate our actions?

No, they are us.